

# Factors Associated with Self-Reported Pneumococcal Immunization among Adults 65 Years of Age or Older in the Minneapolis–St. Paul Metropolitan Area<sup>1,2</sup>

Kristen R. Ehresmann, R.N., M.P.H.,<sup>\*,3</sup> Anita Ramesh, M.S.,<sup>\*</sup> Kathryn Como-Sabetti, M.P.H.,<sup>\*</sup> Diane C. Peterson,<sup>†</sup> Cynthia G. Whitney, M.D., M.P.H.,<sup>‡</sup> and Kristine A. Moore, M.D., M.P.H.<sup>\*</sup>

*\*Acute Disease Epidemiology Section and †Acute Disease Prevention Services Section, Division of Disease Prevention and Control, Minnesota Department of Health, Minneapolis, Minnesota 55440; and ‡Respiratory Diseases Branch, Division of Bacterial and Mycotic Diseases, National Center for Infectious Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia 30333*

**Background.** As part of a 3-year demonstration project to improve pneumococcal polysaccharide vaccine (PPV) coverage among older adults, the Minnesota Department of Health conducted a baseline evaluation of knowledge, attitudes, and beliefs among the general public regarding PPV.

**Methods.** A random-digit dialing telephone survey was conducted among community-dwelling adults age 65 years or older in three metropolitan counties in Minnesota during April through June 1998.

**Results.** Three hundred fifty-three interviews were completed; self-reported PPV coverage was 59% (95% CI 54%, 64%). Nearly all (94%) respondents reported at least one medical visit in the past year. Unvaccinated respondents expressed willingness to be vaccinated if they knew about PPV's safety, dosage, and preventive role. In a final multivariate regression model, factors associated with PPV vaccination included awareness of PPV (OR 7.8; CI 2.1, 29.2;  $P = 0.002$ ), opinion that receiving PPV is "very important" (OR 8.3; CI 3.2, 21.6;  $P < 0.001$ ), awareness that Medicare covers PPV (OR 5.1; CI 1.9, 13.8;  $P = 0.001$ ), physician ever offering PPV

(OR 21.7; CI 6.2, 76.6;  $P < 0.001$ ), and physician regularly offering PPV (OR 3.9; CI 1.1, 13.7;  $P = 0.03$ ).

**Conclusions.** Respondents were significantly influenced by their physician offering PPV. Therefore, providers' practices are a critical target for improving PPV coverage. Educational efforts to inform patients about PPV and to address misconceptions (e.g., safety, efficacy, Medicare coverage) also may improve vaccination levels. © 2001 American Health Foundation and Academic Press

**Key Words:** pneumococcal immunization; older adults; knowledge, attitudes, and beliefs.

## INTRODUCTION

Pneumococcal disease is a significant source of morbidity and mortality in the United States. *Streptococcus pneumoniae* causes an estimated 3,000 cases of meningitis, 55,000 cases of bacteremia, and over 150,000 cases of pneumonia requiring hospitalization annually [1, 2]. This organism causes more deaths than all other bacterial vaccine-preventable diseases combined; together with influenza, it is the leading cause of death due to infectious disease in the United States each year [3]. More than 85% of deaths in the United States attributed to *S. pneumoniae* occur in persons over 65 years of age [4]. Drug-resistant strains of *S. pneumoniae* have been reported widely, including strains resistant to penicillin and other  $\beta$ -lactam antibiotics, erythromycin and other macrolides, trimethoprim-sulfamethoxazole, third-generation cephalosporins, and fluoroquinolones [5, 6]. The emergence of drug resistance limits treatment options and highlights the importance of measures to prevent pneumococcal infection.

A safe and efficacious pneumococcal polysaccharide

<sup>1</sup> This publication was partially supported by the Preventive Health and Human Services Block Grant from the Centers for Disease and Control and Prevention (CDC) and partially supported by the CDC National Center for Infectious Disease Emerging Infections Program. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

<sup>2</sup> This work was presented in part at the 1999 National Immunization Conference, Dallas, Texas, June 22–26, 1999.

<sup>3</sup> To whom correspondence and reprint requests should be addressed at the Minnesota Department of Health, 717 Delaware Street SE, Minneapolis, MN 55440-9441. Fax: (612) 676-5743. E-mail: [kristen.ehresmann@health.state.mn.us](mailto:kristen.ehresmann@health.state.mn.us).

vaccine (PPV) has been licensed in the United States for more than 20 years. The first 14-valent pneumococcal vaccine licensed in 1978 was replaced by the current vaccine in 1983. The current PPV contains the 23 serotypes of *S. pneumoniae* that account for approximately 85% of pneumococcal infections [1, 7, 8]. The Advisory Committee on Immunization Practices (ACIP) recommends that all people age 65 years or older and persons ages 2 to 64 years with high-risk conditions be immunized against *S. pneumoniae* [1].

Numerous studies have demonstrated that current rates of pneumococcal vaccination coverage in the United States are suboptimal [5, 9, 10, 11]. Further, PPV coverage rates have lagged behind those for annual influenza vaccination, although both vaccines are targeted to persons age 65 years or older. The national Healthy People 2000 goal of achieving PPV coverage of 60% among noninstitutionalized persons age 65 years or older has not been met [12]. In Minnesota, PPV coverage levels among persons age 65 years or older increased from 27% in 1993 to 45% in 1998. Although these levels represent substantial progress, they demonstrate that many persons remain unprotected against invasive pneumococcal disease. Furthermore, the level of influenza immunization coverage for persons age 65 years or older increased 51 to 64% during that time period, demonstrating the disparity between vaccination against these two diseases [12, 13].

In October 1997, the Minnesota Department of Health (MDH) initiated the Adult Pneumococcal Immunization Project. The goal of this project was to improve PPV coverage rates among adults age 65 years or older in several major metropolitan counties. As part of this project, the MDH conducted a community-based survey of adults age 65 years or older living in the study area to determine their current knowledge, attitudes, and beliefs regarding PPV. We report here the findings of that survey.

## METHODS

### *Random-Digit Dialing Survey*

The study population included all community-dwelling residents age 65 years or older in three counties (i.e., Dakota, Hennepin, and Ramsey) in the Minneapolis–St. Paul metropolitan area. The total desired sample size ( $n = 350$ ) was determined assuming a binomial distribution to allow a maximum error of 5% around point estimates [14]. Households with a telephone were selected randomly using a modified random-digit dialing technique.

A sample of telephone numbers purchased from a commercial vendor (Survey Sampling, Inc., Fairfield, CT) excluded business and disconnected numbers. Trained interviewers made the telephone calls. Selected

telephone numbers were called until at least 10 attempted contacts had been made; calls were made on various days of the week and at multiple times of day. If answering machines were reached, interviewers left a scripted message requesting that respondents call back to participate in the study or indicate that no one in their household met the eligibility criteria.

Respondents were selected in three stages: (1) a household was selected randomly, (2) the interviewer determined whether an eligible respondent lived there, and (3) if more than one eligible person resided in the household, the respondent was selected based on the most recent birth date. Households were ineligible if no person in the household was age 65 years or older, the number dialed was not a home residence, the number dialed was not a working telephone number, the number dialed was disconnected, or the household of the number dialed was not in the target area. Households in which members were not available during 10 separate telephone attempts, or in which the respondent had physical or linguistic barriers that precluded completing the interview, were considered eligible.

The survey instrument was a standardized questionnaire. Interviewers used nontechnical terms (e.g., “pneumonia vaccine” rather than pneumococcal vaccine) to maximize participants’ comprehension. Respondents were asked about their perception of disease severity, awareness and importance of PPV, and sources of information about PPV. They also were queried on the importance of their physicians’ recommendations and the importance of Medicare’s coverage of the cost of vaccine. Respondents were asked both whether they had received PPV and to identify their preferred venues for vaccination. Unvaccinated respondents were asked why they had not received PPV and what would increase their willingness to be vaccinated.

A series of questions was asked to ascertain respondents’ distinction between PPV and influenza vaccine. All respondents were asked whether they had received PPV, whether they were aware that pneumonia and influenza vaccines are two different vaccines, and how often they had received the “pneumonia” vaccine. They also were asked how often they had received the influenza vaccine within the past year. Finally, respondents were asked about their medical history, sources and frequency of medical care, type of insurance coverage, and basic demographic information.

Twenty surveys were pilot tested in early April 1998 and the information gathered was used to revise the final survey instrument to improve respondents’ comprehension of the questions. The pilot test results were not included in the final analysis. The final study consisted of 353 surveys administered during April through June 1998.

### Statistical Analyses

Univariate analyses were performed using standard microcomputer software (Epi Info v. 6.0; CDC, Atlanta, GA) to calculate odds ratios (OR) and 95% confidence intervals (CI). The Cornfield 95% CI and Yates-corrected *P* value were reported unless otherwise noted; a *P* value of <0.05 was considered statistically significant. Chunkwise unconditional logistic regression models were developed to assess the independent effects of predictive variables while adjusting for confounding factors (SAS System for Windows; Release 6.12; SAS Institute, Inc., Cary, NC). Variables pertaining to similar issues were grouped into chunks. Each chunk was analyzed using a separate logistic regression model; statistically significant variables were combined into a comprehensive model [15].

### RESULTS

Of 5,918 households contacted, 5,274 (89%) were not eligible for the survey. Reasons for ineligibility included households with no respondent age 65 years or older (2,935; 50%), number dialed was not a home residence (1,069; 18%), number dialed was not a working telephone number (675; 11%), number dialed was disconnected as identified by the Survey Sampling screening service (576; 10%), and household was not located in the target area (19; <1%). Of the 644 households with an eligible respondent, 291 (45%) respondents did not participate in the survey; 127 (20%) households dialed were not available during 10 separate attempts, and 58 (9%) households had respondents with physical or language problems; 106 (16%) respondents refused to participate. Three hundred fifty-three surveys were completed, yielding a response rate of 55%.

Of the 353 respondents, 207 (59%) reported having been vaccinated with PPV. Demographic characteristics and PPV vaccination status of the respondents are presented in Table 1. A majority of respondents were white, a majority were female, and the median age was 73 years.

Of the 207 persons who reported having been vaccinated with PPV, 173 (84%) indicated that they had received PPV only once, 25 (12%) replied that they had received PPV more than once, and 9 (4%) did not know how many times they had received PPV. Of the 292 respondents who indicated they had received the influenza vaccine, 286 (98%) reported receiving this vaccine annually.

One hundred forty respondents who indicated they had not been vaccinated with PPV and 6 who were unsure of their vaccination status were queried about barriers to vaccination. Unvaccinated respondents were concerned about PPV's efficacy (21%), PPV's safety (18%), having to make an extra medical appointment (11%), and cost of vaccine (8%); 8% felt they were "too

TABLE 1

Demographic Characteristics of Respondents (*N* = 353)<sup>a</sup>

	<i>N</i>	(%)	Vaccinated	
			<i>N</i>	(%)
Age (years)				
65–74	195	(57)	109	(56)
75–84	123	(36)	76	(62)
≥85	25	(7)	15	(60)
Gender				
Male	124	(35)	62	(50)
Female	229	(65)	145	(63)
Race				
White	327	(98)	193	(59)
Nonwhite	7	(2)	4	(57)
Education				
Some high school or less than high school	38	(11)	31	(82)
High school diploma	120	(35)	69	(58)
Some graduate/technical school or some college	86	(25)	43	(50)
College degree	71	(21)	40	(56)
Postgraduate or professional degree	31	(9)	18	(58)
Marital status				
Married	165	(47)	102	(62)
Single	25	(7)	14	(56)
Divorced	25	(7)	10	(40)
Widowed	133	(38)	77	(58)
Living arrangements				
Alone	137	(40)	81	(59)
With spouse/companion	172	(51)	107	(62)
With children	26	(8)	9	(35)
In assisted living facility	5	(1)	1	(20)

<sup>a</sup> Since unknown values have been excluded, totals in each category may not sum to 353.

sick for more shots" and 8% "did not like getting shots." Factors that unvaccinated respondents indicated would make them more likely to become vaccinated included knowing that PPV could prevent them from being hospitalized or dying from pneumonia (80%), knowing that PPV is safe (73%), and knowing they needed only one shot (68%). Unvaccinated respondents indicated that they would be "very willing" or "willing" to get PPV at a physician's appointment when they were not sick (93%) or at a physician's appointment when they were sick or seeking care (83%). Nonclinic sites such as a hospital/emergency room (42%), retirement center (40%), place of worship (32%), or grocery store (21%) were cited less frequently as preferred venues for receiving PPV.

The frequencies of respondents' medical visits in the past year are presented in Table 2. Overall, 322 (94%) respondents had at least one medical visit within the past year, and those respondents were more likely than those without a visit to have been vaccinated (OR 3.3;

TABLE 2  
Number of Medical Visits in the Past Year by Site and PPV Vaccination Status<sup>a</sup>

Site of medical care	Number of medical visits	All respondents		Vaccinated		Unvaccinated		<i>P</i> value
		<i>N</i>	(%)	<i>N</i>	(%)	<i>N</i>	(%)	
Physician's office	0	25	(7)	9	(36)	16	(64)	0.03
	≥1	310	(93)	189	(61)	121	(39)	
Hospital	0	258	(75)	148	(57)	110	(43)	ns
	≥1	86	(25)	58	(67)	28	(33)	
Emergency room	0	272	(79)	158	(58)	114	(42)	ns
	≥1	72	(21)	48	(67)	24	(33)	
Urgent care facility	0	305	(89)	182	(60)	123	(40)	ns
	≥1	38	(11)	22	(58)	16	(42)	
Any contact with medical system	0	22	(6)	7	(32)	15	(68)	0.01
	≥1	322	(94)	197	(61)	125	(39)	

Note. ns, not statistically significant.

<sup>a</sup> Since unknown values have been excluded, totals in each category may not sum to 353.

95% CI 1.3, 9.9;  $P = 0.01$ ). However, 125 (39%) respondents with medical visits in the past year remained unvaccinated.

Table 3 presents factors significantly associated in univariate analyses with respondents receiving PPV. The most notable significant factor was whether the respondent's physician had offered PPV. Of 168 respondents who indicated that their physicians offered them PPV, only 5 (3%) refused vaccination; 133 (75%) of the

177 respondents who had not been offered PPV by their physicians remained unvaccinated.

Fewer than half (43%) of respondents were aware that Medicare Part B covers the cost of PPV and that they did not have to pay for vaccination. Respondents who were aware that Medicare Part B covers the cost of PPV were more likely (88%) than those who were unaware of this fact (36%) to be vaccinated.

Sixty-one percent (214/353) of respondents had at

TABLE 3  
Factors Significantly Associated with Receiving Pneumococcal Vaccine (Univariate Analyses)

	OR	[95% CI]	<i>P</i> value
Consumer perceptions			
Pneumonia is a serious disease	3.3	[1.3, 8.9]	0.01
It is important to use vaccines to prevent diseases like pneumonia	7.0	[2.7, 19.0]	<0.001
I am aware of the existence of PPV	25.3	[10.9, 60.5]	<0.001
It was <i>very</i> important for me to get PPV	17.3	[9.4, 31.9]	<0.001
It is important to get PPV even if I am healthy	16.4	[7.9, 34.7]	<0.001
I am aware that PPV and influenza vaccine are separate vaccines	9.1	[4.2, 20.4]	<0.001
I am willing to get PPV and influenza vaccine at the same time	2.4	[1.4, 4.1]	0.001
Provider factors			
Doctor told me about PPV	15.6	[7.3, 34.2]	<0.001
Doctor's recommendations are <i>very</i> important	2.2	[1.3, 3.7]	0.003
Doctor offered me PPV	98.5	[35.7, 294.5]	<0.001
Doctor offers PPV some/every time I visit	31.3	[13.1, 78.4]	<0.001
Financial/cost issues			
It was <i>very</i> important for Medicare to pay for PPV	1.9	[1.1, 3.2]	0.02
I am aware that Medicare pays for PPV	12.3	[6.6, 23.3]	<0.001
I have <i>ever</i> gotten the influenza vaccine	3.7	[2.0, 7.0]	<0.001
I have a regular doctor for primary health care	3.2	[1.2, 8.5]	0.01
Respondent characteristics			
Female	1.9	[1.2, 3.0]	0.009
Heart disease	1.8	[1.0, 3.3]	0.04
Diabetes	2.1	[1.0, 4.6]	0.045
Hypertension	1.6	[1.0, 2.5]	0.048
Chronic lung disease	2.8	[1.0, 7.9]	0.04
Visited their physician's office ≥1 time each year	2.8	[1.1, 10.0]	0.03
Had ≥1 encounter with the health care system in the past year	3.3	[1.3, 9.4]	0.01

Note. Respondents answering yes were more likely to be vaccinated with PPV.

least one chronic disease, which is an indication (in addition to age alone) for PPV. Heart disease (79; 22%) was the most commonly reported condition, followed by current cancer (57; 16%), diabetes (43; 12%), chronic lung disease (29; 8%), and kidney disease (6; 2%). Seventy percent of respondents with heart disease were vaccinated with PPV, as were 58% of those with current cancer, 74% of those with diabetes, 79% of those with chronic lung disease, and 50% of those with kidney disease. Respondents with heart disease, diabetes, or chronic lung disease were more likely to have been vaccinated than respondents without these conditions ( $P = 0.04, 0.045, 0.04$ , respectively). However, 31% (67/214) of respondents with a medical indication (in addition to age alone) for PPV had not been vaccinated.

Logistic regression was used to identify the model that best predicted PPV vaccination status using variables found to be significant in univariate analyses (Table 4). Gender and age were not significant predictors of vaccination in univariate analyses but were included in the model as potential confounders. A physician ever offering PPV was the strongest predictor of PPV vaccination. Other significant predictors of PPV vaccination included prior awareness of PPV, the opinion that receiving PPV is "very important," awareness that Medicare covers PPV, and the physician regularly offering PPV.

## DISCUSSION

Although the self-reported PPV vaccination coverage level of 59% demonstrates that this population has nearly achieved the Healthy People 2000 goal of 60% for community-dwelling adults age 65 years or older, 41% remained unprotected against pneumococcal disease. The strongest predictive factor for pneumococcal vaccination among persons age 65 years or older was whether their physician had ever offered them PPV.

TABLE 4

Factors Significantly Associated with Receiving Pneumococcal Vaccination (Multivariate Regression)

	OR	[95% CI]	<i>P</i> value
They were aware of the existence of PPV	7.8	[2.1, 29.2]	0.002
They felt it was <i>very</i> important for them to get PPV	8.3	[3.2, 21.6]	<0.001
They were aware that Medicare pays for PPV	5.1	[1.9, 13.8]	0.001
Their doctor had <i>ever</i> offered them PPV	21.7	[6.2, 76.6]	<0.001
Their doctor offered them PPV some/every time they visit	3.9	[1.1, 13.7]	0.03

*Note.* Respondents answering yes were more likely to have been vaccinated with PPV.

Additionally, awareness of PPV, perception of its importance, provider's persistence in offering PPV, and awareness of Medicare coverage of the vaccine's cost were associated with vaccination.

Consistent with the strong influence of their physician offering PPV, respondents also indicated that they preferred to receive PPV at their physician's office. Most respondents reported visiting their health care provider within the past year, therefore, the health care clinic may be the optimal site to reach this population with PPV. Consequently, successful interventions to increase levels of PPV coverage among community-dwelling seniors should include not only traditional methods of patient education but, more importantly, educational and operational components (e.g., standing orders, chart flags, etc.) targeted to providers and health systems to facilitate the physician offering PPV to eligible patients.

Despite the importance of the provider's role in enhancing immunization coverage, results from this and other surveys suggest that physicians do not routinely offer PPV to all persons age 65 years or older [10, 16–20]. Of 322 respondents who had at least one medical visit during the past year, 125 (39%) remained unvaccinated. Nearly one-third of patients with a chronic medical condition, which is an indication (in addition to age alone) for PPV, had not been vaccinated with PPV. Missed opportunities for vaccination in this population represent potential for increased illness, hospitalization, and mortality due to pneumococcal disease [21, 22]. Interventions designed to address these missed opportunities—including vaccination prior to hospital discharge, use of computer reminders, physician checklists or chart flags, and standing orders—have proven to be extremely effective in improving PPV coverage [23–31].

Systems changes that automate assessment and vaccination procedures have been proposed as an effective intervention to increase the likelihood of the physician offering PPV in the clinic setting [25, 32–36]. Although a recent study by Solberg et al. demonstrated the difficulty in improving overall preventive service delivery rates using systems changes (e.g., continuous quality improvement), pneumococcal vaccination was the only preventive service in their study to significantly increase following intervention [37]. Examples of potential systems changes include patient tracking systems to identify individuals for whom PPV is indicated, designating a nonphysician staff person (e.g., RN, LPN) to focus on preventive care, and use of standing orders in which physicians sign orders for nursing staff to independently assess and vaccinate patients who require PPV [31, 34, 36]. The ACIP recently recommended that standing orders be adopted whenever possible to ensure routine assessment and vaccination of eligible persons [36]. Such systems changes are particularly

important in a problem-focused health care environment in which preventive care may be a secondary priority due to time constraints.

This survey also demonstrates the importance of patients' general awareness about pneumococcal disease and its prevention through PPV. Patient education efforts to address misconceptions about PPV may improve vaccination levels by increasing demand for PPV. Respondents with a good understanding of PPV (e.g., the importance of vaccination, the fact that Medicare covers the cost of PPV) were more likely to be vaccinated. Reports in the literature demonstrate that interventions that enable patients to invest in protecting their health and actively participate in vaccination decisions (e.g., patient-held vaccination record and patient educational materials) yield marked improvements in PPV coverage levels [38–42].

This survey has several limitations. First, several factors associated with vaccination with PPV may have been a result rather than a predictor of having received PPV. For example, it is unclear from this survey whether patients may have received their knowledge about PPV as part of the PPV vaccination process. Since this survey was not prospective, we could not assess this issue. Second, this study used self-reported data, which inherently may have questionable reliability [43–46]. However, several questions were included to reduce the likelihood of respondents confusing PPV and influenza vaccine, thereby enhancing reliability. Additionally, a validation study of self-reported PPV vaccination found it to be a highly sensitive but less specific measure of vaccination status [47]. Third, results may not be generalizable to the U.S. population since nearly all respondents were white and highly educated. However, the three counties from which residents were sampled account for 43% of the state population. Respondents' characteristics reflect the demographics of the population age 65 years or older in Minnesota [48]. Attitudes toward health interventions may differ among minority groups and those with less education. Identifying optimal PPV delivery methods for populations not covered by this survey and those who infrequently access health care may require additional studies.

The findings of this study have several important public health implications. Because our survey respondents indicated that they would prefer to receive vaccine in their providers' offices, interventions should be designed for use in primary venues of health care such as the physician's office. Other types of interventions may be needed for persons with less routine access to health care. Intervention strategies designed for primary health care venues should include resources for both providers and patients. Systems changes likely will enhance physicians' use of PPV. Additionally, patient educational materials (e.g., brochures, posters)

should encourage patients 65 years of age or older to ask their providers for PPV. Implementation of these strategies will maximize PPV utilization for persons age 65 years or older in the primary care setting.

#### ACKNOWLEDGMENTS

We gratefully acknowledge Wendy Mills, M.P.H., and Kristin L. Nichol, M.D., M.P.H., for reviewing the manuscript. We thank Marjorie Ireland, Ph.D., for statistical consultation. We also thank the many Minnesota senior citizens who participated in this survey for their time and insight.

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